Vol. I August, 1916 No. 8

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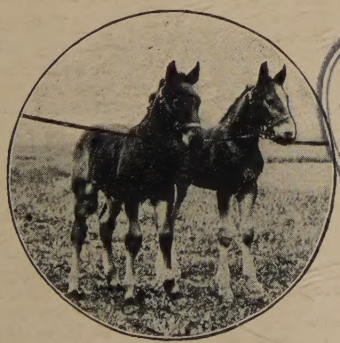
MONTHLY BULLETIN

OF THE

OHIO Agricultural Experiment Station

A report on the progress of the investigations of the Ohio Agricultural Experiment Station, sent free to all residents of the State who request it.



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Monthly Bulletin

of the

Ohio Agricultural Experiment Station

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Artistic tree planting about a Portage County farm home.

Photo by F. W. Calland

MONTHLY BULLETIN

OF THE

Ohio Agricultural Experiment Station

VOL. I AUGUST, 1916 No. 8

WHEAT EXPERIMENTS[1]

C. G. WILLIAMS

TIME OF SEEDING

Experiments have been in progress at the Ohio Experiment Station for 14 years in which seedings of wheat have been made each fall on nine different dates, separated by intervals of 1 week. These seedings have been begun August 31 or September 1 and have been concluded October 26 or 27.

There has been considerable variation in yield from these seedings in different seasons. For 7 of the 14 years the seedings made September 21-22 have led in yield; those made September 28-29 have led three times; and September 14-15, twice.

In 6 different years the seedings made October 26-27 have given a yield of more than 20 bushels per acre, twice more than 25 bushels and once more than 28 bushels. Three times this latest seeding has been less than 10 bushels per acre, and once a total failure.

The 14-year averages are as follows:

Date drilled	Bushels per acre
Aug. 31—Sept. 1	27.44
September 7—8	30.20
September 14—15	32.26
September 21—22	34.54
September 28—29	32.91
October 5—6	28.40
October 12—13	26.23
October 19—20	20.96
October 26—27	17.64

As an average of all the tests, the seedings made September 21-22 have given the largest yield, with those made September 28-29 second, and those made September 14-15 third.

[1]Extract from Ohio Agr. Exp. Sta. Bul. 298.

RATE OF SEEDING

Experiments extending over a period of 17 years have been conducted to determine the proper rate of seeding, ranging in amount from 3 to 10 pecks per acre. The different varieties used in this test are Valley, Rudy, Poole, Fultz, Red Wonder, Gypsy, Early Ripe, Nigger, Mediterranean and Red Wave. The average of these ten varieties is given in Table I. From the combined average, as shown in this table, it will be seen that there is a gradual increase in yield from 3 to 9 pecks, with the single exception of the 7-peck rate. The yield from 10 pecks is identical with that from 9 pecks.

TABLE I.—Rate of seeding

Pecks of seed used per acre	Bushels harvested per acre	
	Total yield	Net yield
Three	24.24	23.49
Four	26.18	25.18
Five	26.98	25.73
Six	28.19	26.69
Seven	28.06	26.31
Eight	28.96	26.96
Nine	29.06	26.81
Ten	29.06	26.56

In determining the profitableness of a given rate of seeding it is proper to consider the total yield less the amount of seed used. If this is done it will be noted that 8 pecks is the most profitable rate, with 9 pecks second and 6 pecks third. While the difference in the net yield between the 6- and 8-peck rate is not large, it affords a profit of 54 percent upon the extra seed invested.

METHODS OF SEEDING

Drilling vs. broadcasting.—Experiments were conducted for five seasons to compare three depths of drilling with broadcast seeding. In one season of the five the broadcasting stood highest in yield, but in three seasons it was lowest; and in one of the latter it yielded considerably less than one-half as much as the drilled wheat. The weather conditions following wheat seeding were responsible for the unusually low yield from broadcasting in 1892. The rainfall in September, 1891, was less than 28 percent of the average September rainfall for the last 27 years, while the October rainfall was only a little more than one-half the average. Such seasons may be expected occasionally, and they are quite injurious to wheat which is broadcasted and covered only with a harrow.

While there were some slight seasonal variations, on the average of the five tests there was no difference in the yield of wheat from 1- and 2-inch drilling, and but little disadvantage in the 3-inch drilling. The results are as follows:

TABLE II.—Depth of drilling and broadcasting

Method of seeding	Yield per acre (bushels)					
	1887	1890	1891	1892	1893	5-year average
Drilled 1 inch deep	38.1	22.6	31.0	34.0	18.0	28.7
Drilled 2 inches deep	37.8	25.0	32.7	30.0	18.2	28.7
Drilled 3 inches deep	35.8	22.0	32.7	30.7	21.3	28.5
Sown broadcast	34.7	24.6	34.7	13.2	17.1	24.9

Cross-drilling.—Three tests have been made by this Station of drilling seed wheat one way of the field, as compared with both ways. In the latter method the seed was divided and one-half drilled each way. The results of these tests show a slight gain for the cross-drilling, viz, 0.76 bushel. While this might pay for the extra work in going over the field a second time with a drill, the margin is so close that it will hardly pay to take the chances. Wheat drilling, once over, is often delayed by rains so that serious losses occur from the delayed seeding. Doubling the work of drilling would further increase the chances for loss. There is, therefore, little encouragement for cross-drilling. In Table III the yields of grain and straw are given for each season together with the average of the three.

TABLE III.—The effect of cross-drilling

Method of seeding	Yield per acre							
	1891		1892		1896		3-year average	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
	Bushels	Pounds	Bushels	Pounds	Bushels	Pounds	Bushels	Pounds
Drilled one way	.53	3,228	16.95	2,239	28.25	2,260	23.91	2,576
Cross-drilled	27.36	3,308	18.89	2,351	27.75	2,200	24.67	2,620

COUNTY COOPERATION TO CONTROL HESSIAN FLY

H. A. GOSSARD AND G. R. EASTWOOD

Our first effort in Ohio to organize farmers in a definite territory to act as a unit in deciding on the date for seeding wheat in order to avoid damage by Hessian fly, was made last fall.

Plan of organization.—The original movement toward organization was made by a few farmers of Elizabeth Township, Miami County, where the crop had been partly destroyed by the fly for several consecutive seasons. These requested the aid of their county agent, M. C. Thomas, who was superintendent of the Miami County Experiment Farm, and he in turn requested the help of the Station entomologist in the movement. At a public meeting an organization was effected, one man being appointed in each school district to solicit his neighbors to sign a pledge to await the advice of the entomologist and the county agent as to the date of seeding. Most of the farmers pledged themselves as desired, thinking that matters could hardly be worse with them under such a plan than had been the case for several seasons previous.

The next step was to write to the entomologists of states who had tested out the cooperative plan of seeding most thoroughly and to obtain from them a statement of results. We also obtained through the Kansas Station entomologist statements from Kansas county agents and farmers who had worked under the plan. Multiple copies of these letters were distributed to the various committeemen, and some of them were published in the county papers.

Early in the campaign Mr. Thomas accepted another position, and the junior author succeeded him as county agent and was in charge of the publicity campaign.

Egg-laying records obtained.—Probably the most effective factor in securing confidence in our project was the installation of a breeding cage and the keeping of an egg-laying record at the County Experiment Farm. When the farmers learned that we were not merely guessing at the date when the flies had gone, but had a definite method for determining when the brood was past in their own county under the conditions of 1915, they were quite willing to wait for any reasonable length of time before seeding in order to learn our results. The farmers of the whole county, rather than of a single township, almost unanimously awaited our signal to sow wheat.

The breeding cage was simply a wooden box 2 to 3 feet long, about 2 feet wide and perhaps 16 or 18 inches high. The box had

no bottom, and in the top was a small hole over which a lantern globe was placed and covered with cheesecloth. Stubble and top soil containing puparia in abundance was collected from a plot badly infested the preceding season, dampened, and put into the cage on September 14. With a magnifying glass the junior writer differentiated the Hessian flies each morning from the other flies appearing in the cage and kept the daily record of the hatch. A few days after September 14, hog-nose rings were put around 100 wheat plants located at intervals down a suitable drill row, and all Hessian-fly eggs were removed from the blades of these plants by rubbing with the finger. On the following day and on each succeeding day for a period of about 2 weeks, the eggs found on these plants were counted and then removed. When the egg-laying record showed a maximum rate and was beginning to decline, following a few days after the maximum emergence of flies in the cage, it was concluded that the crest of the brood was well past and the date for seeding at hand, since the wheat could not be up and of a size to invite the flies until about 2 weeks later, by which time it was expected that practically all the flies would have disappeared.

Time of seeding.—The record was not published until September 27, when the signal was given through the county papers to sow. Very few fields in the county had been sown prior to this time, and these few were outside the badly infested districts. Nearly all the seeding was done October 1 to 20, and during the fall no fly developed.

Results satisfactory.—An inspection trip was made through the infested districts on November 9. Not a single Hessian-fly larva or pupa could be located in any farm field in the county, though the date plots on the County Experiment Farm, sown September 1, September 15 and September 22, were practically destroyed. Millions of larvae and pupae were found in volunteer wheat that had sprung up in uncut fields or among the clover in cut fields. Where this volunteer wheat was pastured with cattle or sheep, conditions were less threatening. Some farmers were found plowing such fields, intending to plant corn on them the next spring. By a newspaper article the plowing of such fields, so far as possible, was encouraged. Many farmers, discouraged by repeated failures to obtain a crop, abandoned the idea of sowing wheat at all and no effort was made to discourage in any way this reduction in acreage.

An examination of Hessian-fly conditions in Miami County made June 28, 1916, indicates that the success of the experiment has been better than was expected with so much fly in the volunteer wheat last fall. A small percentage of infestation could be found

in some fields, but probably not 5 percent in the worst. In other words, the whole county is reduced to a normal infestation; and, except in a few cases, the farmers can seed this coming season at their convenience. Some fields that were sown unusually late, following a corn crop and on poor land, may be in danger of being left uncut, and such fields contain sufficient fly to menace nearby fields somewhat if such are seeded early. It will be best not to seed such fields before October 1 and probably best not to sow at all near them. While seeding at convenience will apparently be safe this season for nearly all Miami County, it is quite possible that two or three seasons of the practice will bring about a return of the fly; therefore, the county agent will keep a close watch on developments and give warning if such a misfortune can be foretold.

At the County Experiment Farm the wheat plots seeded the first week in October are best; those sown before the 25th of September were badly injured or almost destroyed by the fly; and those sown after the 13th of October were winter-killed, the latest sown ones being about as poor as the September plots. Where wheat was sown on fairly good land between October 1 and 10, the seed bed being properly prepared and fertilized, the crop is good. Some farmers having a poor crop will attribute it to the late sowing, but an inspection of the County Farm date plots ought to convince them that they would have had a still poorer crop had they seeded early enough to catch the fly damage.

Infestation in other districts.—Since we know of no extensive districts outside Miami County that were equally infested with the fly, unless it may have been Clermont County and a few townships in Greene County which were likewise quite well organized for late seeding, we have no satisfactory check upon the apparent result. However, we know that last year and in preceding years many fields had practically 100 percent of infestation; this year the worst are scarcely if any more than 5 percent as determined by the two authors counting and inspecting conjointly. The average yield may not prove greater for Miami County than it did last year, but the condition is entirely changed. Instead of gambling by sowing wheat with the odds against him, as has been the case for several years in Miami County, the farmer can sow this fall with confidence that he will suffer but little from Hessian fly. Neither last fall nor now do parasites or other natural agencies seem to be enough in evidence to account for the marked transformation. Weather conditions both last fall and this spring have not been unfavorable for Hessian fly. We know of fields only two or three counties north of Miami County where the infestation ranges 50 percent or higher.

COCKROACHES AND THEIR CONTROL

V. R. HABER[1]

Cockroaches were among the first insects to appear upon the earth in the early geological ages and are the only insects the ancestry of which is continuously traceable from the time when they first appeared to the present. During these ages they have become distributed everywhere over the earth.

Description.—They are particularly characterized by having flattened bodies with their heads bent under the front end. They have one pair of black, kidney-shaped eyes. The two feelers, located on the front of the head between the eyes, are long, thread-like and composed of many small joints. The first pair of wings is thickened and acts as a cover for the more delicate, folded second pair. No organs of hearing have yet been found and in all probability these insects cannot hear.

CROTON BUG

a-d, nymphs; e, male; h, female; f, female and egg mass; g, egg mass.

Habits.—Although the cockroach externally may appear as rather cleanly, a less superficial acquaintance with it forces the careful observer to regard it as one of the filthiest of insects. The species inhabiting our dwellings are now considered characteristically omnivorous—eating anything from the choicest food to the filthiest refuse with seemingly the same relish. Microscopic examinations of the contents of the stomachs of freshly killed specimens have shown them to be reeking with various bacteria and fungi. Thus they become one of the worst enemies to public health, in that they transmit disease. Bacteria, as the tubercle,

[1]Of the Ohio State University.

typhoid, anthrax and cholera bacilli, may pass through the cockroach unchanged. Moreover, the legs and bodies are admirably adapted to carrying filth and disease germs.

Cockroaches are able to swim as soon as they can run about. Because of their flattened form they can creep into crevices, behind loose woodwork and wallpaper, around water pipes and similar places. They are particularly fond of narrow, damp, dark, warm quarters. From such haunts they emerge at night to run at random over almost anything within their reach.

Their characteristic, nauseating odor is especially noted when large numbers gather in close quarters. This "roachy" odor comes from the saliva and from the secretion of glands under the rear-wing tips.

Bedbugs are said to be exterminated by cockroaches. However, introducing the latter may often establish a still more serious pest than the bedbugs, and control measures for both will then become necessary. It is known that no two species of cockroaches will visit the same haunts.

The cockroach requires a comparatively long time to reach maturity. The white, newly laid eggs become gradually darker to hatching time, a period requiring approximately 39 days. The young insects seek sheltered places in about 6 to 7 days later to shed their skins, a process that requires about one-half an hour or even less. This molting occurs six times before maturity is reached, which is about 96 days after hatching. After each molt the cockroach is white in color, gradually becoming darker. Wings are developed after the final molt. The females will breed in 16 to 28 days afterward.

The German cockroach.—Cockroaches have been introduced into the United States from Australia, South America and Europe. Of these the German species (*Blatella germanica*), also called the "Croton bug" and "water bug," has become of greatest importance through its appearance in bakeries, kitchens and storehouses. The adults are yellowish-brown insects about one inch long and five-sixteenth of an inch wide, the females being heavier and darker with lighter brown legs; the shieldlike part covering the head, as well as the fore body, is marked with dark brown to black, longitudinal stripes; the wings and wing covers extend well to the rear of the body, those of the female being the longer. The feelers are longer than the closed wing covers.

Control measures.—Trapping and poisoning methods usually prove unsatisfactory, due to the fact that places infested with cockroaches offer a copious food supply. Hence they shun nearly all poisonous baits however attractive.

For this reason other remedial measures must be sought. Substances with a pitch or tarlike odor are most satisfactory, and constitute a large part of roach insecticides. Spraying the walls thoroughly so that every crevice is reached, and washing the floors of the room with water to which spray material has been added, is quite effective when repeated at intervals of 2 days for a week to 10 days. The crevices about the floors and walls should then be tightly closed. This rendering conditions unsuitable to the liking of the insects is the most successful way to control them.

Powdered borax is also an effective material to rid a room of cockroaches. The floors and walls should be scrubbed with water in which liberal quantities of borax have been dissolved. The walls and ceilings should then be sprinkled with the borax. Not only is it repulsive to cockroaches, but it also kills any insects that chance to eat it, although no danger is thus incurred to higher animals. Burning the borax in a tightly closed room will kill or stun cockroaches.

Strong solutions of creosote, or creolin, are excellent repellents. Some commercial contact insecticides (as "Tornado Bug Exterminator" or "Killitol") are effective when thoroughly sprayed in all crevices in floors, walls and ceilings.[1] Carbon bisulphide readily vaporizes when exposed to the air under ordinary circumstances, the fumes being deadly poison to insect life. However, care must be exercised to keep it from fire and to have no openings in the room during fumigation. Twelve pounds per 1,000 cubic feet of room space should be put in open vessels as near the ceiling as possible, as the gas, being heavier than air, sinks to the floor. The temperature should be as near 70° F. as possible. After 12 to 24 hours' fumigation, the room should be thoroughly ventilated.

Hydrocyanic gas is used in like manner, but because of its poisonous characteristics is not generally recommended.

A place once freed from cockroaches should be kept scrupulously clean. Loose woodwork should receive the attention of a carpenter. By observing precautions so as not to refit suitable environments, these pests should be easily held in check.

[1]At the Experiment Station "Insectolene" has been found remarkably effective when used according to manufacturers' directions.—R. D. Whitmarsh.

THE USE OF DYNAMITE IN CLEARING LAND

EDMUND SECREST

Clearing land of its original timber requires considerable effort and financial outlay. In many cases the cost of direct clearing, including the removal of the stumps, exceeds the value of the land after it is cleared. While numerous methods may be employed in clearing, the usual way is to remove the trees, marketing such as are merchantable and burning the waste in heaps. The areas are then pastured until the stumps and roots rot sufficiently to be easily removed by hand grubbing or with a team. In some cases stump-pulling machinery has been used to remove green stumps, but the time and labor involved make this operation expensive. Moreover, it must usually be supplemented with a variable amount of digging and root cutting. Stump pullers work more economically and effectively on partly decayed stumps, or those where the roots have been decayed to the point where they will break easily. The most satisfactory means of clearing land, however, is by the use of dynamite.

COST OF CLEARING

The cost of clearing land to make it immediately available for tillage varies with the size and number of trees, the species and the soil. A portion of a second-growth oak forest was cleared on the Station farm a few years ago at a cost of approximately $40 an acre, while in another part of the same forest the cost was as high as $70 an acre. In these two cases the ground was put in shape for tillage. The species were white and black oak and hickory, the trees ranging from 3 to 10 inches in diameter. Trees with large taproots, such as hickory, oak and walnut, are naturally more difficult to grub than maples and beeches, whose roots are more inclined to develop laterally.

This spring a number of stumps were blown with dynamite on the site of the forest nursery, on which cost records were kept. The stumps ranged in age from the time of cutting the trees from 6 months to 25 years. There was also a wide range in species and in size of stumps. In the accompanying table is given the species, size of stump, length of time cut, amount of dynamite and the total cost of removal per stump.

In most of this work 40 percent dynamite costing about 20 cents a pound was used. Some stumps were blown with 60 percent explosive, but the results were no more satisfactory, and the cost

was higher. The costs as given in the table include only the removal of the stumps. The lateral surface roots were not removed to any extent. It should be noticed that some of the stumps had been standing for more than 20 years. Large green oak stumps will increase the cost considerably, and the increase will not vary as the diameter, but as the square of the diameter of the stump.

TABLE I.—Cost of dynamiting stumps

No.	Species	Diameter of stump	Number of years cut	Number of sticks of dynamite*	Total cost
		Inches			Dollars
1	White Oak	30	20–25	3½	0.79
2	" "	36	20–25	3	.74
3	" "	30	20–25	3	.62
4	Beech	8	4– 5	1	.20
5	Hickory	11	4– 5	2	.45
6	Hickory	16	4– 5	2½	.67
7	Chestnut	28	10–15	4½	.91
8	Black Oak	20	4– 5	1¼	.31
9	White Oak	12	4– 5	1	.25
10	" "	26	20–25	3	.49
11	" "	24	20–25	2	.38
12	Maple	24	8–10	3	.49
13	Black Oak	12	5	2	.38
14	" "	15	10–15	1½	.29
15	" "	10	5	1	.27
16	" "	20	6– 8	1¼	.31
17	" "	24	4	4	.80
18	" "	15	8–10	2	.36
19	" "	18	8–10	2	.41
20	" "	18	10	2	.46
21	White Oak	12	8–10	2	.43
22	Black Oak	24	5	3	.42
23	White Oak	6	1	1	.27
24	Maple	14	1	2½	.33
25	Cherry	12	1	1½	.32
26	Black Oak	13	1	2	.42
27	" "	13	1	2½	.48
28	" "	24	5	5½	1.08
29	Maple	24	5	2	.55
30	Chestnut	15	10–12	3	.54
31	Black Oak	13	1	2½	.80
32	Black Gum	14	5	5½	.97
33	White Oak	30	25	2½	.45
34	White Oak	18	25	1½	.32
35	Black Oak	12	5	2	.45
36	" "	18	1–15	3	.56
37	" "	14	2	2½	.77
38	" "	12	2	3	.65
39	Cherry	10	5	1½	.32
40	Black Oak	20	4	4	.60
41	Black Oak	12	3	1½	.39
42	Hickory	14	1	3	.60
43	Hickory	14	1	3½	.75
44	Black Oak	12	5	2	.51
45	Hickory	14	1	4	.90
46	Black Oak	34	3	7	1.14
47	White Oak	30	4	7	1.38
48	White Oak	42	5	9½	1.52
49	Cherry	30	1	9	1.68
	Average	18		3	.59

*A stick of dynamite weighs one-half pound.

HANDLING THE EXPLOSIVE

Precautions.—Blowing stumps satisfactorily and economically requires some experience. In the first place one needs to be extremely careful in handling dynamite and the fulminating caps

which discharge it. Still a careful man can handle them with comparative safety. Experienced blasters may be hired for $2 a day, but usually they charge more. The directions which accompany each box of the material should be studied and accurately observed. Effectiveness in stump blowing depends upon knowing the proper amount of dynamite to use for different stumps, and where to place it, both of which will come by experience. Proper placing of the charge will not only save dynamite, but minimize hand grubbing as well.

Position of auger in drilling the tunnel.

Tools.—The tools required for blasting stumps are an ordinary wood auger, a wooden tamping rod, a pair of pliers and a 30-penny nail. The auger which is used for drilling the tunnel under the stump should be 1½ inches in diameter. An extension arm must be welded to it so that the entire length will be about 4½ feet. At the end of the arm an eye can be made to hold a wooden handle about 18 inches long. A broom or fork handle 4 feet long will suffice for a tamping rod. The pliers are used for attaching the percussion cap to the fuse and the nail for punching a hole in the dynamite stick for the percussion cap.

Directions.—The tunnel should be bored at an angle of 45° directly to the taproot, or approximately the center of the stump.

Some stumps if large and green require more than one tunnel, but the tunnels should all center at the taproot or directly under the stump and should be opposite or at right angles to each other. Boring into the taproot is sometimes necessary. The cartridge, or dynamite stick, should be primed with the percussion cap according

The results of a well-placed charge.

to manufacturers' directions and the charge pushed gently into place with the tamper. If more than one stick is used in a tunnel the cartridge containing the percussion cap should be inserted last. It is a good plan to remove the wrappers from the first sticks used, tamping them gently to the bottom of the tunnel and then to push the primed cartridge in its wrapper down so that it will rest firmly on the others. After the sticks have been set, drop a little earth in the tunnel, gently tamping it until the tunnel is about half full. After that the tamping can be firmer, as the tunnel is filled. Never tamp violently nor drive the tamper with a stone or hammer.

The longer stumps stand the easier they are blown. Therefore, if the use of the land for tillage is not necessary, it would pay well to utilize it for pasturage a few years before blowing the stumps. Heavy pasturage preferably with sheep is necessary in cut-over land to keep down the sprouts. Spring is the most favorable time for blasting stumps as less dynamite is required and the blast is most effective.

POTATO EXHIBITS

S. N. GREEN

With the rapidly increasing interest in potato exhibits at local county and state fairs, it seems necessary that some standards in judging be adopted, so that there may be a better understanding between exhibitor and judge. Without such standards confusion as to requirements is certain to occur.

Object of exhibits.—From the exhibitor's standpoint as well as the public's, the benefits of fair exhibits are chiefly educational. The main consideration in judging potatoes should be to place them according to their relative position with regard to their value as seed. Thus, premium money, though often a powerful incentive, should be of secondary importance. Unfortunately, potato growers do not have the experience in exhibiting and judging that corn and apple growers have, and from these brother growers they can learn several lessons. With this in mind, some tentative suggestions in potato exhibiting may now be made for trial and later revision.

In the first place, selection of seed potatoes requires a knowledge of the several characteristics of the tuber and their probable significance in relation to yield. While the seed alone is not responsible for a crop, still it is an important factor. Moreover, its importance is increasingly great when one considers the part it may play in doubling the present average Ohio potato yield of 100 bushels.

However, the yield of potatoes is not the only important object sought by growers and exhibitors. Of course, fancy points will always have some weight. Still, other main objects should be of greater moment, such as quality, uniformity of size and appearance. Already market quotations modify prices for Ohio, Red River and other stocks, and demands are greater for Rural, Triumph and like varieties. Probably quotations will soon call for "baking," "mashing," and other special grades.

POTATO VARIETIES

Varieties in Ohio.—While half a dozen varieties of potatoes would fill all our present needs, we find almost innumerable sorts listed in county-fair premium lists. In 37 such lists consulted 208 varieties were recorded, of which 108 were listed for a single county. Only twelve varieties were listed by 10 counties or more in common, and only seven by 30 or more. These seven, which

may well be named Ohio standards, are: Beauty of Hebron, Carman No. 3, Early Ohio, Early Rose, Green Mountain, Irish Cobbler and Rural New Yorker No. 2.

If these seven varieties alone were planted by Ohio growers with a view to improvement, the others might well be discarded. To aid in this improvement few means are of greater importance than potato exhibits.

Variety identification.—Because of the numerous varieties and the attendant confusion, it is necessary for the potato exhibitor to have a general knowledge regarding their classification. The following groups are adapted from U. S. Department of Agriculture Bulletin 176, "Group Classification and Varietal Descriptions of Some American Potatoes."

1.—**Cobbler.** An early class rapidly becoming popular among market gardeners. Tubers roundish with blunt ends, often notched deeply. Eyes medium in number and usually deep. Skin smooth and light creamy-white color.

2.—**Triumph.** Early varieties. Tubers usually roundish. Skin white, splashed with carmine or a solid red. Flesh creamy white.

3.—**Early Michigan.** Early varieties. Tubers oblong-flattened to ovoid. Eyes numerous. Skin white or creamy white, occasionally with pinkish eyes.

4.—**Rose.** Early varieties. Tubers elongated or oblong, with a tendency to become rather blunt. Skin smooth and usually of pink color. Eyes numerous and rather shallow.

5.—**Early Ohio.** Early and late varieties. Tubers roundish-oblong with full-rounded seed and stem ends. Eyes numerous and rather shallow. Skin light pink with few exceptions. Surface more or less numerously dotted with small corky spots.

6.—**Hebron.** Mostly late varieties. Tubers elongated, somewhat flattened, occasionally spindle-shaped. Eyes numerous and rather shallow. Skin creamy white or light pink.

7.—**Burbank.** Late varieties. Tubers long and cylindrical, inclined to be prongy. Eyes numerous and shallow. Skin white or russet.

8.—**Green Mountain.** Late varieties. Tubers broadly roundish-flattened to distinctly oblong-flattened; ends usually blunt, especially seed end. Eyes medium in number and rather shallow. Skin dull creamy-white, netted or russet.

9.—**Rural.** Late varieties. Usually distinguished from Group 8 by the "blue sprout," the "white sprout" being characteristic of the latter. Tubers roundish to oblong-flattened. Eyes few, shallow. Skin creamy white, occasionly netted.

10.—**Pearl.** Late and unusual varieties in Ohio. Tubers roundish or heart-shaped, flattened. Eyes rather shallow with heavy eyebrows. Skin white, russet or deep violet.

11.—**Peachblow.** Late and little grown in Ohio. Tubers usually roundish. Eyes usually few and deep, and suffused with carmine. Skin white, flesh-colored or deep pink.

The following 52 varieties are the ones most commonly found in Ohio. The number indicates the group to which the variety belongs.

Acme (5)
American Giant (8)
American Wonder (8)
Banner (8)
Beauty of Hebron (6)
Bliss Triumph (2)
Blue Victor (10)
Blue Mechanic (10)
Bovee (6)
Burbank (7)
Burpee's Extra Early (2)
Carman No. 1 (8)
Carman No. 3 (9)
California Russet (7)
Crown Jewel (6)
Early Everett (4)
Early Fortune (4)
Early Michigan (3)
Early Ohio (5)
Early Petoskey (1)
Early Puritan (3)
Early Rose (4)
Early Six Weeks (5)
Early Walters (4)
Empire State (8)
Eureka Extra Early (1)
Gold Coin (8)
Green Mountain (8)
Irish Cobbler (1)
Late Ohio (5)
Lee's Favorite (4)
Livingston (4)
Maggie Murphy (4)
Maxima (4)
New Queen (6)
Peachblow (11)
Pearl (10)
Potentate (1)
Prosperity (9)
Rural New Yorker No. 1 (8)
Rural New Yorker No. 2 (9)
Russet, Dibbles (9)
Seneca Beauty (4)
Sir Walter Raleigh (9)
Spauldings No. 4 (4)
Twentieth Century (8)
Uncle Sam (8)
White Elephant (8)
White Giant (9)
White Ohio (5)
Whitons White Mammoth (8)

PREPARATION OF AN EXHIBIT

Field treatment.—The preparation of a potato exhibit should begin at planting time. The seed should be true to name, and should be treated to prevent scab and other diseases. Then too, the soil should be well suited to this crop, and should be thoroughly cultivated during the growing season. Spraying the vines at frequent intervals should be practiced.

The potatoes for exhibition purposes should then be dug by hand unless large fields are planted. About ten times the required number for exhibiting should be selected at this time, so that they may be again sorted after storage. Selected tubers should be wrapped in soft paper for packing or storing.

Display.—The package, or number of tubers exhibited, is usually determined by the contest rules, but ordinarily five specimens are shown. If peck lots or large packages are specified, the packages should be furnished by the management in order that uniformity may be secured in their appearance.

There is a strong tendency to have potatoes displayed in the same manner as in the case of apples, that is, in shallow trays. This style is recommended, especially for large potato exhibits. There is the objection that potatoes do not adapt themselves as readily to regular packing as do apples, but still with experience in selection and skill acquired in packing remarkably attractive exhibits can be arranged in such boxes.

By following these suggestive directions and by studying groups and varieties, the potato exhibitor may attain a higher degree of efficiency in his exhibiting. He should also familiarize himself with the score card, which will be taken up in a later article.

HANDLING THE WEED SITUATION

A. D. SELBY

While weed cutting may be observed for purely aesthetic reasons, the further consequences are possibly of larger value. For the sake of appearance, unless the summer visitors arrive early, it may make little difference whether the weeds are mown before or after the formation of seeds. The intrusion of the weeds may be removed by mowing; yet it is certainly showing mismanagement to delay weed cutting until after viable seeds are produced in large quantities. The month of August is obviously the month for weed cutting. The principle to be applied is to mow areas infested with weeds in time to prevent seed formation. It is true that August cutting is not early enough to prevent seed ripening of whitetop in meadows, nor all ripening of seed of prickly lettuce, docks, the mustards, pigweeds, and even golden hawkweed. The meadow-infesting weeds will be cared for in the harvesting of the forage crop. This applies to all cuttings alike, whether of the early alfalfa and clover, or of the later timothy and meadow grasses.

New seedings.—The newly seeded clover fields and meadows, especially those seeded in a grain crop, such as rye, wheat or oats, present another side of the problem. The history of showery midsummers, as a rule, is one which shows wheat stubble and even oat stubble generally overgrown with ragweed and foxtail-grass. The doctrine of good business culture requires that these new seedings be saved from competition with any weeds, and that they be fostered by a freer opportunity for full growth and development in the later season. Clipping new seedings in August is therefore necessary.

Mowing briers and low brush.—The after-harvest lull in work affords also an opportunity for clearance of semiwaste places occupied by briers or overgrown by low brush. Despite the older doctrines that there are especially favored times for such cutting, experience teaches that the earlier the cutting is done and the more frequently it is followed up, the more effective is the killing out of the pestiferous growth. Here we do well to remember that some of this waste growth occupies land that would be profitable if seeded to some pasture crop like bluegrass. Such a crop, however, may require specific fertilizer or cultural treatment. The rule suggested is to make pasture soils adapted to the growth of pasture, and then the problems of weed control disappear.

SOME ESPECIALLY PREVALENT WEEDS

Reed canary grass (*Phalaris arundinacea*) is a vigorous growing grass supplied with many underground stems like quackgrass,

and is a near relative to the European grass supplying the well-known bird seed. Recently specimens were received for identification from Hockingport, Athens County, and from Apple Grove, southern Meigs County, both points being near the Ohio River. It is known to flourish in moist lands, even though subject to overflow. It produces at most points in Ohio two heavy cuttings of palatable hay, and will protect bottom lands subject to overflow or abrasion by streams, and shows full ability to occupy any ordinary lands where seeded. It may have considerable value for permanent seeding of lands likely to be flooded in the early season. It is locally found at widely scattered points.

Golden hawkweed.—The range of golden hawkweed (*Hieracium aurantiacum*) has been reported in past years from various points in Ashtabula, Geauga, Trumbull, Portage, Mahoning, Columbiana and Stark Counties. More recently it was received from Morrow County. This weed propagates itself by creeping stems, or stolons, thus spreading freely over pasture lands of a somewhat forbidding soil character. Several collections have been reported from the vicinity of Salem, Chardon, Alliance, Ravenna, Garrettsville, Thompson's Ledge and Warren. It is worth while in each locality to make an earnest effort to destroy the orange hawkweed. This has been successfully done in Vermont by sowing salt broadcast over occupied ground, the application being made at the rate of 2 tons per acre. These salt applications do not kill the grass.

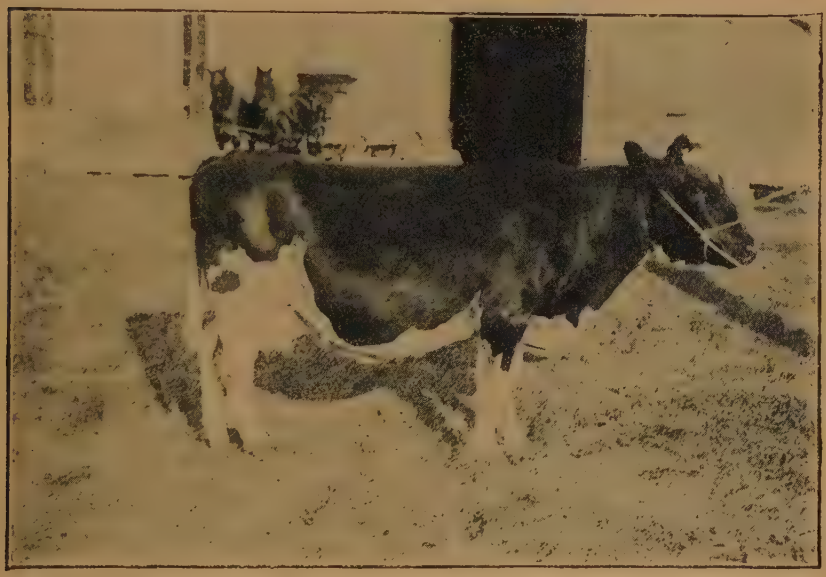
White snakeroot (*Eupatorium* [*ageratoides*] *urticaefolium*) is a rather tall growing plant of the Composite family, nearly related to the common boneset. The heads are white in color, as indicated by the name, and are rather attractive in appearance. The plant has broadly egg-shaped, coarsely toothed, pointed, long-stalked opposite leaves, 3 to 5 inches long. It is frequent in low bottom pastures and along the borders of woods, as well as in rather open woods. It causes the disease known as milk-leg in cattle and trembles in sheep and cattle. In recent years losses of livestock from poisoning by this plant have occurred at Johnstown, Licking County, and Sharpsburg, Athens County. Since this is quite a frequent weed in bottom areas along small streams adjoining wood pastures, warning is given to guard against leaving stock free to run where such growth occurs. Frequent cutting off with a hoe and salting is an effective means of eradication.

Identification of plant specimens will be made by the Department of Botany. It is always desirable to have collections showing all parts such as roots, stems, leaves and flowers or fruits.

DOES IT PAY TO TAKE EXTRA CARE OF COWS?

C. C. HAYDEN

Most good dairymen take pride in having their cows look well and produce well. Just as pride in one's self and family costs more, so likewise additional expense is incurred in giving cattle extra feed and care. In the case of his family the dairyman expects no money return for the expenditure, but most men are in the dairy business for the financial returns which it may bring.



Cow No. 1

Extra feed and care mean more salable cattle and larger production of milk. The writer has often wondered if the change which may be brought about by more feed and better care is generally known and appreciated. It is probable that the production of all herds now poorly or only fairly well cared for could be doubled by careful feeding and better care. Of course, the first question asked will be, Does it pay?

The records presented in this article show what may be accomplished with cows that are supposed to be well fed. The Station does not put its cows under test for admission to the Advanced Register or Register of Merit. However, the records are carefully kept. The milk is weighed and sampled at each milking and all

feed weighed and recorded. The cows are used for experimental purposes and could be given official tests only when not used in some experiment.

Recently a few cows calved at a time when it was not desirable to use them in regular experiments. Though not officially tested, those whose records are reported here were put under official test conditions during their last lactation period. They were given better care and extra feed and were milked three times daily for a part of the year. They were kept in their stalls with the remainder of the herd, but were made as comfortable as convenient there. A comparison of their production under these conditions with their previous production shows a marked increase—79.6 percent in milk and 67.3 percent in fat, by one cow, and 87 percent and 80 percent, respectively, by the other.

In these records, one year from the birth of each calf was taken as the lactation period. Cow No. 1 had four lactation periods previous to the test.

The picture of cow No. 1 was taken soon after the close of the test and a few days before she dropped her next calf. The writer has never seen this cow in better condition than at that time. Besides the extra milk produced, she has added greatly to her body weight. Tables I and II show her record.

TABLE I.—Production and feed consumption of cow No. 1.

Lactation period	Production		Feeds consumed				
	Milk	Fat	Grain	Silage	Hay	Stover	Days on pasture
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	
Fifth	14,722.0	400.0	5,115	8,330	2,321	482	174.0
Average of first four	8,194.0	239.0	2,420	6,127	2,087	302	165.0
Difference, or increase	6,528.0	161.0	2,695	2,203	234	180	9.0
Percent of increase	79.6	67.3	111	36	6	6	5.4

TABLE II.—Cost of milk production of cow No. 1.

Lactation period	Total cost of feeds	Feed cost of		Total cost of	
		100 lb. milk	1 lb. fat	100 lb. milk	1 lb. fat
	Dollars	Cents	Cents	Dollars	Cents
Fifth	114.97	78	20	1.23	36.0
Average of first four	72.97	89	22	1.57	45.7
Difference, or increase	42.00	64	16	.80	22.5

Cow No. 2.

Cow No. 2 had five lactation periods previous to the test. Her record is given in Tables III and IV.

TABLE III.—Production and feed consumption of cow No. 2.

Lactation period	Production		Feed consumed				
	Milk	Fat	Grain	Silage	Hay	Stover	Days on pasture
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	
Sixth	15,318	505	6,208	9,131	2,444	42	174
Average of first five	8,195	280	2,393	6,160	2,086	419	131
Difference, or increase	7,123	225	3,815	2,971	358	—377	43
Percent of increase	87	80	159	48	17	— 90	33

TABLE IV.—Cost of milk production of cow No. 2.

Lactation period	Total cost of feed	Feed cost of		Total cost of	
		100 lb. milk	1 lb. fat	100 lb. milk	1 lb. fat
	Dollars	Cents	Cents	Dollars	Cents
Sixth	130.46	85	18.5	1.28	31.6
Average of first five	70.74	86	18.0	1.545	38.0
Difference, or increase	72	84	18.8	.98	23.0

Note that the *feed cost* of the difference, or increase of product of cow No. 1 was 25 cents less per 100 pounds of milk and 6 cents less per pound fat, while the *total cost* of the increase was 77 cents less per 100 pounds milk and 23 cents less per pound fat.

In the record of cow No. 2 the *feed cost* of the difference, or increase of product was 2 cents less per 100 pounds milk than in her previous periods and the fat practically 1 cent more per pound. The *total cost* per 100 pounds milk was 56.5 cents less for the increase and 15 cents less per pound fat.

In these calculations, the following charges other than feed were made: labor $30; taxes, interest, depreciation, etc., $20; barn rent $4; tools, etc., $2; and in the case of butterfat, 30 cents per 100 pounds was credited for the skimmilk.

The prices used for feeds were as follows: grain $25 per ton; silage $5 per ton; hay $15 per ton; stover $5 per ton, and pasture $2 per month. This price for grain may seem low now but it is probably about representative of the time covered by the records.

Though the increase was gained at about an equal feed cost, it was produced at a great reduction when all costs are considered. It took no more stable room and practically no more time to feed, water or clean the stables than previously, but it did require extra time to milk three times daily for a part of the year. However, this would not be equal to one-third the labor previously required though this much was charged against the extra production. No credit was given for the increased value of the manure. The value of the manure would be greatly increased because of the larger amount of concentrates which it was necessary to feed.

If a gain like this can be made with cows that are reasonably well fed, what could be done with the many dairy herds which are so poorly fed? Just how far this heavier feeding can safely be carried is a question that is not settled. It is safe to say that it can be carried much beyond the common practice in at least one-half the dairy herds of Ohio. The man who couples this practice with the methods suggested in a previous article on the selection of sires will succeed in the dairy business.

A note of warning should be sounded here. The man who has purebred cattle should not dispose of his own cattle and purchase others with high records until he has developed the possibilities in his own herd. There are many cows now producing moderately which would make high records if given a chance. Many such cows are purchased by experts, developed and sold at high prices.

THE NUTRITION OF SOIL BACTERIA

E. R. ALLEN

One of the procedures that must be developed in the study of the complicated problem of soil biology is the isolation and growth of the different soil bacteria in the laboratory. Investigators in this field have been frequently confronted with the fact that these organisms once removed from the soil and placed in artificial nutrient solutions do not grow as rapidly as they did in their natural habitat. Like practically all other soil phenomena the problem is a most difficult one for solution, and the results obtained and the conclusions drawn by one investigator do not always agree with those of another. For instance, some investigators have found that extracts of soils (obtained by shaking the soil with water and then filtering) when reinforced with the regular nutrient salts support the growth of certain bacteria better than any nutrient solution prepared entirely from known materials.

Chemical theory of Kaserer.—The Austrian investigator, Kaserer, believed that this is due to certain rare substances contained in the soil in such minute amounts as to escape detection, and that these substances have a decidedly beneficial effect on certain soil bacteria.

Physical theory of Söhngen.—The beneficial effect of the addition of soil and humus to culture solutions is also often very striking. Thus, the Polish investigators, Severin and Helena Krzmieniewski, found that the addition of humus to cultures of *Azotobacter chroococcum*, a nitrogen-fixing soil bacterium, produced a decided increase in growth and fixation of nitrogen. The Dutch bacteriologist, Söhngen, obtained some results pointing in this same direction and believes that the superior action of soil rests in its physical properties, particularly its power to absorb substances out of solution and gases out of the air. The soil by absorbing nutrient substances out of solutions, prevents too rapid feeding at the start but releases them gradually later as the growing bacteria need them, thus acting as a savings bank.

Difficulty in isolating nitrifying bacteria.—Of all groups of known soil bacteria the nitrifiers are among the most difficult to isolate and grow in the laboratory. A soil may possess a vigorous nitrifying power, but when an attempt is made to isolate pure cultures from this same soil or even perform the nitrification in artificial solutions, the growth in the solution is extremely slow or fails

altogether. (Nitrification, as here used, is the process whereby ammonia in soil and natural waters is changed to nitrite and nitrate.)

Experimental data.—In the hope of throwing some light on this problem the following experiments were carried out:

Extracts from a fertile soil from Paulding County in its natural condition and also after it had been ignited to destroy organic matter, were prepared and the regular nutrients added to them. Equal portions of these solutions and also of the regular nutrient solutions were placed in flasks and inoculated with cultures of the organism that converts nitrite into nitrate. All cultures grew slowly but were maintained in the incubator for more than 2 months. The differences in growth between the different cultures were not wide; those in the regular nutrient solutions growing more slowly at the start but more rapidly later on, while those prepared from the nonignited soil grew more slowly than the others. The experiment shows, therefore, that if certain rare substances are of importance to the nutrition of these bacteria they were not present in this particular Ohio soil.

In a second experiment in which different porous substances were used just enough solution was mixed with the porous material to moisten it well. These mixtures were then inoculated, and the amount of nitrate produced from ammonia was determined at the end of a definite incubation period. The results shown in the accompanying table are expressed relatively, the nitrification in the sand cultures (average of three) being taken as 100.

Medium	Nitrification
Sand	100
Sand plus humus	310
Soil—natural	235
Soil—ignited	361
Soil—ignited plus humus	381
Sand and carbon black, equal volume	106
Carbon black	106

Conclusions.—These results show that soil is superior to sand for the support of nitrification, and that the addition of humus improves the sand while the addition of carbon black does not. Both humus and carbon black remove substances from solution by absorption, but the action of the two in this experiment has been quite different. Ignition of soil, which would destroy its humus, helped rather than injured its power to support nitrification. The addition of humus to ignited soil exerted but little effect upon nitrification. The experiments, however, do not confirm or disprove either the physical or chemical theory.

CLASSIFICATION OF SOILS IN A SOIL SURVEY

W. C. BOARDMAN

Soil surveys have been started in various states to define and classify soils, and also to identify, describe, map and correlate them over large areas. The system of classification adopted by the U. S. Bureau of Soils is at present most widely used in this work. While it may need further revision, its use is to be encouraged because Federal supervision will go far towards national uniformity in soil classification.

Soil differences.—Soils vary according to origin, mode of formation, climate, size of particles, and relative position on the earth's surface. Soils varying in any one or more of these characteristics may have widely different crop-producing powers. These differences may often be traced to variations in the rocks from which the soils were formed. Thus, there are great differences in soils of limestone origin, for instance, and those formed from sandstone or shale. Soils from two limestone rocks may even differ in certain respects. Moreover, the forces causing rocks to break up to form soils may differ greatly, and thus still further differences in the resulting soils are caused. These agencies include freezing and thawing, action of water and wind, chemical action, and plant and animal life. Soils may remain where formed, or again they may be carried down hills, or in streams or other bodies of water, or possibly by wind or ice sheets, to points far distant from the original rock. Then by various physical and chemical agencies the properties of these same soils may be changed, depending upon the nature and extent of action of such forces. Plants and animal remains may also contribute a share in this process of soil formation.

Therefore, as a result of these many differences in soils due to their origin and mode of formation, many types of soils are found today. In fact about seven thousand have been mapped in the United States. The identification and mapping of these types constitute, in the main, the work of those engaged in a soil survey.

Provinces and regions.—These soils are mapped by the U. S. Bureau of Soils in 13 areas into which the country has been divided. Soils in any one of these areas will have much the same character, as they have been formed by similar forces from rocks of close resemblance. The seven areas lying east of the Mississippi River

are called "provinces"; while the larger western tracts, in which the soils have not been so carefully worked out, are designated as "regions."

Soil series.—The second step in the classification of soils was to form a series, which is a group of soils similar in color; in subsoil, particularly with regard to color and structure; in type of relief and drainage; and in origin. By structure, as here used, is meant the arrangement of soil particles. For instance, a clay soil may be almost impervious to water, or it may be full of pores which allow good drainage. Porous soils, therefore, would not fall into the same series as those of tight structure. Likewise, steep-sloped soils are differentiated from those in lowlands, and well-drained soils from those with little drainage. The soils in a given series must also have the same color.

Soil groups.—The third step in the classification is to divide the soil into groups having relatively the same size of particles. For this purpose a mechanical analysis is made in the laboratory. In this analysis a sample is divided into "soil separates" of standard size, as follows:

Gravel	- 2 millimeters
Fine gravel	2 mm. - 1 mm.
Coarse sand	1 mm. - 0.5 mm.
Medium sand	0.5 mm. - 0.25 mm.
Fine sand	0.25 mm. - 0.1 mm.
Very fine sand	0.1 mm. - 0.05 mm.
Silt	0.05 mm. - 0.005 mm.
Clay	0.005 mm. - 0

Soil classes.—A group having, within certain limits, the same percentage of soil separates is called a soil class. There are 13 of these classes as follows: coarse sand, medium sand, fine sand, very fine sand, sandy loam, fine sandy loam, sandy clay, loam, silt loam, clay loam, silty clay loam, silty clay and clay.

These soil classes vary greatly in the percentage of the soil separates they may contain. Thus coarse sand has more than 25 percent fine gravel and coarse sand, less than 50 percent medium sand, fine sand and very fine sand, and less than 20 percent silt and clay. Clay has more than 30 percent of its particles less than 0.005 millimeter in diameter. Between these classes there are various gradations.

Soil types.—The final step in the classification is to designate the soil type, which is a soil class in a soil series. For example, "Miami" stands for a soil series. "Miami sandy loam" is a soil type. Though any series may contain all classes, there are few that do.

THE VALUE OF MANURE AS COMPARED WITH CHEMICAL FERTILIZERS

C. E. THORNE

The complete fertilizer used on Plot 11 in the Ohio Experiment Station's 5-year rotation at Wooster has carried 76 pounds of nitrogen in nitrate of soda, 20 pounds of phosphorus in acid phosphate and 108 pounds of potassium in muriate of potash for each 5-year period. The cost of this application has been computed at $23.50, or at 19 cents per pound for the nitrogen, 13 cents for the phosphorus and 6 cents for the potassium. The 20-year average value of the increase produced by this fertilizr, as shown in Circular 144, has been $39.28, corn being valued at 40 cents per bushel, oats at 30 cents, wheat at 80 cents, stover at $3 per ton, straw at $2 and hay at $8. On these valuations for fertilizers and produce, $1 expended in fertilizers has produced $1.67 in increase of crop.

Plot 17 in the same experiment has received 38 pounds of nitrogen, 30 pounds of phosphorus and 108 pounds of potassium, costing $17.60 for each rotation, and has produced increase to the value of $35.23, or $2 in increase for each dollar expended in fertilizers.

Plot 18 in this experiment has received 16 tons of barnyard manure, 8 tons each on corn and wheat, taken from the open barnyard in the spring and in August, and being plowed under for corn and spread on the surface after plowing for wheat.

The manures used in the Station's special manure tests were analyzed for 5 years by J. W. Ames and his assistants, and were found to contain on the average the following elements per ton:

	Nitrogen	Phosphorus	Potassium
Yard manure .....pounds..	9.0	2.0	6.0
Stall manure .....do....	13.3	2.3	10.0

If we assume that about 20 percent of the nitrogen in the stall manure had escaped before it was plowed under, as seems probable from late investigations, and use the same valuations employed for the chemical elements in nitrate of soda, acid phosphate and muriate of potash, the nitrogen, phosphorus and potassium in a ton of yard manure would cost $2.33 and in a ton of stall manure, $2.85, if purchased in these carriers. The cost of the chemicals carried in the 16 tons of yard manure used on Plot 18 would therefore be $37.28. The value of the increase on this plot has been $40.40 for each 5-year period, or nearly $1.09 for what would have cost $1 if purchased in chemical fertilizers.

Plot 20 in this test has carried only half as much manure as that given to Plot 18, and has produced increase to the value of $24.54, or nearly $1.32 for each dollar in chemical values.

In the special manure test, which has been running since 1897, the 16-year average value of produce for 8 tons of untreated yard manure has been $20.80, while from 8 tons of stall manure it has been $26.24, or approximately $1.12 for one dollar in chemicals in yard manure and $1.15 in stall manure .

Where the manure has been treated with acid phosphate in this test, the value of the produce, after deducting the cost of the acid phosphate, has been $33.77 for 8 tons of yard manure and $39.12 for 8 tons of stall manure, or $1.81 for each dollar in chemicals in the yard manure, and $1.71 in the stall manure. In this calculation, however, no credit is given to the acid phosphate beyond the returning of its cost, whereas all our experiments show that acid phosphate is sure to return much more than its cost when properly used.

Apparently there has been no great difference in the effectiveness of the chemical elements in the two manures, the greater total effect of the ton of stall manure over the ton of yard manure being chiefly due to the larger total quantity of elements contained in the stall manure.

The lesson to be drawn from these results is that the man who is purchasing fertilizers cannot afford to pay quite as much for the pound of nitrogen, phosphorus or potassium spread on his fields in barnyard manure, as he would pay for the pound of the same elements in nitrate of soda, acid phosphate and muriate of potash also laid on his fields; or, to put it in another form, open-yard manure of good quality should not cost him more than about $2 a ton, and manure fresh from the stable not more than $2.50 a ton, spread on his fields, as compared with nitrate of soda at $60 a ton, 16 percent acid phosphate at $18 and muriate of potash at $50 properly compounded and spread on the field.

On the other hand, the man who can produce and spread on his farm annually 100 tons of manure from well-fed animals may safely assume that that manure properly cared for, used in systematic rotation of crops and supplemented with acid phosphate, bonemeal or raw phosphate rock, may be expected to produce, as an average for a long term of years, as large an increase of crops as he would obtain from an annual expenditure of $200 to $250 in chemical fertilizers.

LOW-GRADE, READY-MIXED FERTILIZERS

C. E. THORNE

The following is a sample of many inquiries that come to this Station:

"Inclosed find price list of fertilizers. Is the company reliable, as far as you know? Are tobacco stems a good filler, and what value would they have in fertilizers?"

Fertilizer inspection.—Replying to the first question we have to say that we have no means of judging the reliability of different fertilizer concerns excepting through the official reports of fertilizer analyses published by the Ohio State Board of Agriculture, Columbus, which reports are sent free to any person who will ask for them. In these reports are listed the names of all brands of fertilizers licensed to be sold in the State, together with their guaranteed analyses and the actual analyses as found by the chemists charged with this work. If the product of any fertilizer company should fall materially below this guaranteed analysis, it is wise for the farmer to deal with some other firm.

Tobacco stems in fertilizers.—Tobacco stems are frequently used as carriers of ammonia and potash in fertilizers. Many analyses of such materials have been made by the eastern experiment stations, notably those of Connecticut and Massachusetts, which show a wide range in composition. As a general average tobacco stems may be expected to carry about 2½ percent ammonia and 6 percent potash. Such materials are regularly used in the ready-mixed fertilizers offered in the Ohio market, and while not as effective, pound for pound, as the ammonia in such materials as nitrate of soda and sulphate of ammonia, and the potash in the muriate or sulphate of potash, they are what the farmer usually buys, in part at least, who purchases any ready-mixed fertilizer.

Fertilizer costs.—In one price list sent to us occurs a brand having an enticing name and the following formula:

Available ammonia	½	percent
Potash, actual	½	"
Available phosphoric acid	11½	"

The ammonia is said to be derived from blood, tankage and tobacco stems. The price quoted is $20 per ton. A ton of this fertilizer would carry one-half of one percent of 2,000, or 10 pounds, of ammonia, the same quantity of potash, and 230 pounds of available phosphoric acid.

In the same price list a 16-percent acid phosphate is quoted under a fancy name at $19 per ton. A ton of this phosphate would carry 320 pounds of available phosphoric acid, which would therefore cost 6 cents per pound. At this price the 230 pounds of phosphoric acid in the mixed fertilizer first mentioned would cost $13.80, leaving $6.20 to pay for the 10 pounds each of ammonia and potash.

A ton of ordinary barnyard manure, if handled with reasonable care to avoid loss of its constituents by leaching or heating, will carry more than 10 pounds each of ammonia and potash. The farmer who purchases such a fertilizer as the above-described mixture is therefore paying the equivalent of $6.80 per ton for barnyard manure.

The Ohio Station's experiments have shown that when barnyard manure is used after the practice common on many farms—that is, after lying some months in an open barnyard exposed to the weather—a very large part of its fertilizing value is lost; but when kept under cover until ready to go to the field and then reinforced with acid phosphate, its ammonia and potash are fully equal, pound for pound, to the same elements in tobacco stems or similar materials.

As shown in the preceding article, the chemical elements in manure are somewhat less effective than the same elements in nitrate of soda or sulphate of ammonia and muriate of potash, but these materials are superior in effectiveness to much of the material ordinarily used in the compounding of such low-grade fertilizers as the one described.

The ordinary dose of fertilizer is about 200 pounds per acre. Hence, a ton of fertilizer would be spread on 10 acres. The farmer who has 10 acres to fertilize, therefore, has his choice between paying $20 for a ton of the mixture above described or paying $13.80 for 1,453 pounds of 16-percent acid phosphate and supplementing it with one ton of stable manure.

Any farmer who keeps one pair of horses and one cow will produce sufficient manure in his stable in a year to cover 150 acres if he uses manure as sparingly as he would use ammonia and potash in the fertilizer mixture under consideration.

RECENT TECHNICAL BULLETINS

Any of the following bulletins in the original series may be obtained by writing to the Experiment Station, Wooster:

No. 290—Varieties of apples in Ohio: Descriptions of the trees and fruit of 116 Ohio apple varieties, along with results of storage tests, records of blooming periods, disease susceptibility, apple sections of Ohio, and a discussion of quality in apples.

No. 291—Experiments with laying hens: Comparisons of lots of hens kept on range and in confinement; of lots fed variety and simple rations, and of lots fed various amounts of protein in the ration Abstract in June Monthly Bulletin.

No. 292—Sulphur in relation to soils and crops: The sulphur supply of soils, results of field and laboratory tests with sulphates and with other forms of sulphur on various crops, and the influence of sulphur on the production of acidity and the solubility of phosphorus.

No. 293—The grape-berry worm: Complete description, life history and habits of the insect, results of experimental spraying tests in Lake Erie section in 1907-15, with recommendations for control. Abstract in May Monthly Bulletin.

No. 294—Wool studies: Results of experiments to determine the effect of washing before shearing, and of the time of shearing, on the yield of grease wool and of scoured wool and on the rate of gain in live weight. Abstract in May Monthly Bulletin.

No. 295—Mineral metabolism of the milch cow: A study of the mineral income and outgo of the milch cow on common practical rations, with detailed tables of experimental data. Abstract in June Monthly Bulletin.

No. 296—Ohio weather for 1915: Maps and summary tables giving the temperature and precipitation during the year.

No. 297—The clover leaf tyer: Food plants, character of damage, life history and habits, complete description and control measures included. Abstract in June Monthly Bulletin.

No. 298—Wheat experiments: Rotation tests, results of fertilizer treatments and of cultural methods, relation of weight of kernel to yield, variety tests, improving wheat by selection. Abstracts in July and August Monthly Bulletins.

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LAKE
GEAUGA
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CUYAHOGA
LORAIN
ERIE
SANDUSKY
WOOD
OTTAWA
LUCAS
FULTON
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DEFIANCE
HENRY
PAULDING
PUTNAM
HANCOCK
SUMMIT
PORTAGE
MEDINA
BENECA
HURON
MAHONING
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MERCER
AUGLAIZE
MARION
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